Nonlinear Effects of Dynamic Export Pricing on Export Sales: A Longitudinal Investigation

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ABSTRACT

Little is known in the literature about dynamic export pricing, particularly how the external environment interacts with a firm's export pricing decisions and its long-term effect on export sales. Therefore, this study develops a longitudinal framework to examine the quadratic effect of dynamic export pricing and its interaction with customer/competitive turbulence on export sales. By employing product-level longitudinal data, the authors also estimate the lagged effect from past dynamic export pricing and export sales, while simultaneously controlling for endogeneity and unknown firm heterogeneity. The results indicate that dynamic export pricing appears to have inverted quadratic effects on export sales; this quadratic relationship is moderated by customer turbulence and competitive turbulence. The authors also focus on the changes of the curve and shifts of the turning point, and delineate the fit lines that pinpoint the optimal dynamic export pricing in different export markets. Finally, previous actions and outcomes significantly influence the following year's export sales, which explains the long-term relationships.

Keywords*: Dynamic export pricing strategy; Export sales; Longitudinal study; Dynamic panel model*

INTRODUCTION

Pricing is one of the most important marketing strategies for a firm as it has direct and immediate effects on revenue (Liu and Zhang 2013). Dynamic pricing, in which prices vary over time, has been widely adopted in practice (Chen et al. 2017). The importance of dynamic pricing becomes more evident in international marketing due to the rapid changes and intense competition in global markets. In the exporting context, changing prices promptly and accurately is particularly important as firms tend to export to several foreign markets simultaneously but with diminished control over individual markets (Spyropoulou et al. 2018). In our study, we focus on *dynamic export pricing* which refers to changes in export prices from previously posted prices over a certain sales period.

While dynamic pricing has been widely investigated in the revenue management and marketing area (e.g., Chen et al. 2017; Rajan et al. 1992; Transchel and Minner 2009), little is known about dynamic pricing for exporting firms (Tan and Sousa 2011). Specifically, there are three research gaps relating to dynamic export pricing. First, the current literature largely ignores the real-world context of dynamic pricing. The majority of studies build up analytical models to derive optimal pricing strategies under the conditions of monopoly (e.g., Gallego and Van Ryzin 1994; Popescu and Wu 2007; Rajan et al. 1992) or oligopoly (e.g., Kopalle et al. 1996; Levin et al. 2009). However, those studies tend to use experiments with small groups of participants (e.g., Haws and Bearden 2006; Yuan and Han 2011) or do not consider the competition context (e.g., Zhang et al. 2014). Not surprisingly, there has been a call for future studies to generalize the application sphere of dynamic pricing (Zhang et al. 2014). Moreover, given the complexity and turbulent environment that characterizes the international market, the exporting context of dynamic pricing is intrinsically different from the monopoly and oligopoly scenarios (Chabowski and Mena 2017). These differences, combined with the

importance of dynamic export pricing for exporting firms and the lack of research in this area, emphasize the need for further research.

Second, past studies have not considered moderating effects when examining dynamic export pricing. In practice, exporters not only face a simple question of whether to change their export prices, but must also take into account the environment in which these decisions occur. Specifically, customer and competitive turbulence can moderate the effect of dynamic export pricing on export sales differently: such turbulence can strengthen/weaken the relationship between dynamic export pricing and export sales (changes of the shape) and can shift the best dynamic export pricing effort that fits an individual market (shifts of the turning point). However, a large proportion of studies do not clearly theorize the differences between these two types of effects with many hypotheses being double-barreled, which may limit theoretical understanding of an inherently complex issue and even lead to confounded findings (Burkert et al. 2014; Haans et al. 2016).

Third, the literature fails to investigate the time dimension of dynamic export pricing. Although some researchers have developed analytical models to highlight the importance of time and theorize the differences between the short- and long-term effects of dynamic pricing (e.g., Popescu and Wu 2007; Schwartz and Smith 2000), they have not explicitly considered it in an international context. Moreover, most studies have not used real transaction data to empirically test their models (e.g., Chen et al. 2017; Kopalle et al. 1996; Levin et al. 2009). To establish a deeper understanding of dynamic export pricing practices, it is crucial to employ a sufficient set of real transaction data across time, industry and countries. It is particularly interesting from the perspectives of international marketing theory and practice to empirically investigate the long-term effects of dynamic export pricing on export sales and seek the evolutionary fitness of dynamic export pricing.

The dynamic capabilities (DC) perspective is used in this study to highlight that the effect of dynamic export pricing on export sales is subject to the changing environment. The DC perspective stresses that firms need to achieve alignment of marketing strategies with external conditions, where such alignment is a source of sustained competitive advantage (Eisenhardt and Martin 2000). Thus, drawing on the DC perspective, this study investigates the relationship between dynamic export pricing and export sales by considering the moderating effects of customer and competitive turbulence. Accordingly, the study addresses three important research questions: (1) What is the relationship between dynamic export pricing and export sales? (2) How does customer/competitive turbulence moderate the relationship between dynamic export pricing and export sales (including both changes of the shape and shifts of the turning point)? (3) What are the differences between short- and long-term effects of dynamic export pricing on export sales?

This study's contributions to the literature are threefold. First, we contribute to the literature on dynamic pricing by extending it into a more complex context: exporting. By employing a large-scale product-level panel data set, we investigate a curvilinear relationship between dynamic export pricing and export sales. As customers observe a large deviation between current and previous export prices, they may change their purchasing decisions. Thus, it implies a non-linear relationship between dynamic export pricing and export sales. Our results suggest that, although exporting firms are capable of adjusting export prices to a great extent, ever-increasing pricing dynamism does not always generate superior export sales.

Second, this study identifies customer and competitive turbulence as new boundary conditions that affect dynamic export pricing–export sales relationships. This allows us to contribute to the DC perspective by clarifying its boundary conditions, which is an important precondition to enable a theory to move forward (Barreto 2010; Schilke 2014). This is important because

the effects of firms' capabilities have been theorized as being subject to environmental changes (Feng et al. 2017; Morgan et al. 2012). Moreover, by examining both changes of the shape and shifts of the turning point, this study responds to the research call to separately theorize these two moderation types of a curvilinear relationship (Haans et al. 2016). The fit between dynamic export pricing and environment turbulence is not a single value, but rather a set of shifted solutions across different markets (Burkert et al. 2014). Connecting the turning points across different markets constitutes a *fit line*, which delineates the best dynamic export pricing effort that fits different levels of turbulence. By plotting fit lines, we empirically pinpoint the sales-maximizing dynamic export pricing configuration in different export markets. This is theoretically important as it indicates that strategic adjustment of dynamic export pricing is driven by the misfit between existing strategic decisions and the changing environment. Increasing dynamic export pricing may not always benefit exporting firms in a turbulent environment. The fit between dynamic export pricing and customer/competitive turbulence provides a valuable guideline for the deliberation of dynamic export pricing in individual export markets.

Third, this study contributes to the literature by considering the time dimension and empirically examining the framework using a large transactional dataset. This effort consolidates the conceptual results of analytical modeling studies, which builds crucial bridges between the theory and data (Popescu and Wu 2007). Our results illustrate the differences between the short- and long-term effects of dynamic export pricing on export sales in practice, where a short-term fit may drift into a long-term misfit. Moreover, we employ a panel model with controlling firm-year fixed effects that capture the unobserved individual heterogeneity and time effects. While exploring the long-term effects, we employ the dynamic panel model with system generalized method of moments (GMM) to control for endogeneity issues (Uotila et al. 2009).

THEORY AND HYPOTHESES

A Review of Dynamic Pricing in the Literature

Traditional pricing research has studied different pricing schemes that suggest periodically changing price over time (Tellis 1986). These pricing schemes suggest the price variation by comparing with a fixed benchmark price, e.g., the launched price. In this manner, the future price is predictable and not necessarily unknown to the customers (Tellis 1986). Dynamic pricing has received considerable research attention in revenue management and marketing literature (Elmaghraby and Keskinocak 2003). Table 1 summarizes the representative research on dynamic pricing.

Insert Table 1 about here

In terms of the literature on revenue management, the majority of studies develop analytical models to derive optimal dynamic pricing policy. Some of these studies focus on the relationship between dynamic pricing and inventory over a finite selling period (e.g., Aviv and Pazgal 2005; Zhao and Zheng 2000). Other studies examine dynamic pricing under the conditions of monopoly, duopoly or oligopoly, where little competition exists (e.g., Rajan et al. 1992). Dynamic pricing has also received attention in the marketing literature. For instance, studies have examined dynamic pricing from a consumer viewpoint by considering the circumstances that affect price fairness judgement (e.g., Haws and Bearden 2006); investigated the effect of consumers' price expectations on dynamic pricing (e.g., Yuan and Han 2011); or focused on the impact of pricing decisions in business-to-business (B2B) relationships that are governed by trust (e.g., Zhang et al. 2014).

Overall, most studies on dynamic pricing develop analytical models that only consider a small number of participants (sellers or buyers), and test them using numerical simulated data or experiments. Empirical studies using actual transactional data to examine dynamic pricing are very rare. The study by Zhang et al. (2014) is one of the very few empirical studies using actual transaction data, but it is restricted to a single industry and does not consider the competition. Hence, this study differs from previous works in that we use real transaction data to examine dynamic pricing for exporting firms across different industries and export markets. Although the literature on international marketing has focused on export pricing (e.g., Sousa et al. 2014), it draws largely on a static pricing regime that suggests standardization/adaptation of posted export prices. Importantly, export pricing strategy is not a static strategy, but rather a dynamic and long-lasting activity (e.g., Myers et al. 2002; Tan and Sousa 2011). Therefore, this study adds to the literature on export pricing by considering the dynamic aspect, referring to export prices variation across time and circumstances. Moreover, we analyze the moderating role of customer/competitive turbulence on the relationship between dynamic export pricing and export sales, which further facilitates the adaptation of optimal dynamic pricing across international markets over time.

Theoretical Background

Dynamic capabilities refer to a "*firm's processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match and even create market changes*" (Eisenhardt and Martin 2000: 1107). It explains why and how some firms with dynamic capabilities succeed in a rapidly changing environment (Barrales-Molina et al. 2014; Wilden and Gudergan 2015). In the international marketing literature there has been growing interest in the use of dynamic capabilities to explain a variety of different outcomes

(Morgan et al. 2018). Specifically, dynamic capabilities have been used to explain topics such as product innovation (Yalcinkaya et al. 2007); international joint ventures (Fang and Zou 2009); performance of foreign-owned affiliates (Konwar et al. 2017); and role of stakeholders in the marketing capability–building processes of international new ventures (Evers et al. 2012). In an exporting context, the first major study that draws on the DC perspective was by Morgan et al. (2004). Subsequently, a stream of other studies were published using the DC perspective to explore firms' export activities (e.g., Morgan et al. 2012; Spyropoulou et al. 2018; Tan and Sousa 2015; Villar et al. 2014).

The DC perspective complements the findings on export behavior research, as it explains the evolution of resources over time (Villar et al. 2014). Strategic outcomes can be viewed as "market-based assets" that update the exporting firm's existing resource repository (Morgan et al. 2004). Dynamic capabilities allow firms to utilize such updates and adapt marketing strategies, thereby creating superior marketing processes to match external marketplaces (Morgan et al. 2012). However, in the literature, there is very little empirical evidence that substantiates the effects of dynamic capabilities (Schilke et al. 2018). In this study, we use the DC perspective to investigate the dynamic export pricing–performance relationship and the moderating role of customer/competitive turbulence. It posits that dynamic export pricing is not linear and mindless, but is, instead, a sensitive and cognitively mindful strategy (Ambrosini and Bowman 2009; Haws and Bearden 2006).

Dynamic export pricing is considered as an adaptive capability that shapes export sales in foreign markets (Dutta et al. 2003; Tan and Sousa 2011). This adaptive capability is firms' ability to reconfigure export pricing strategies for foreign markets. In the exporting context, the empirical literature provides significant evidence of the positive relationship between dynamic capabilities and performance (Chabowski and Mena 2017). Nevertheless, it is

important to notice that such positive relationship is not unbounded, as continuously increasing the capability adaptation can be detrimental (Cadogan et al. 2009). The export pricing reconfiguration processes are dissipative as they are in a continuously unbalanced state of slipping into the categories of being either too much or too little. The typical linear postulation may not adequately explain the relationship between dynamic export pricing and export sales, where continuously increasing export pricing dynamism does not always lead to growing export sales. Thus, there is a need to examine the nonlinear relationship between dynamic export pricing and export sales.

Furthermore, given the continuously changing environment, the resource-based view fails to explain firms' competitive advantages (Eisenhardt and Martin 2000). The DC perspective extends the resource-based view by proposing that in a rapidly changing environment, there is a need to exploit dynamic capabilities that enable a firm to adapt to changes in the environment (Chabowski and Mena 2017). Dynamic capabilities consist of a specific process of strategic decision-making that aims to achieve an alignment with a changing environment, where such alignment creates competitive advantage (Eisenhardt and Martin 2000). The literature has shown that the dynamic capabilities–performance relationship is altered by customer turbulence (referring to changes of customers' demands) and competitor turbulence (referring to changes of competitors' movements) (Wilden and Gudergan 2015). Facing customers and competitors changes, exporting firms need to use semi-structured routines and apply real-time and experiential information to create strategic reconfiguration routines (Eisenhardt and Martin 2000). Different levels of customer/competitive turbulence require different dynamic export pricing that leads to maximum sales. This suggests that dynamic export pricing and customer/competitive turbulence interactively shape export sales. Thus, in this study, we posit two specific moderation effects of customer and competitive turbulence on the nonlinear relationship between dynamic export pricing and export sales.

In addition, the sustained competitive advantage is shaped by the persistent alignment of dynamic capabilities with a changing environment over time (Zollo and Winter 2002). Previously operated strategies and the corresponding outcomes shape firms' unique prior knowledge that can further affect their later sales and the size of this influence could infer the probability of a sustainable competitive advantage (Otley 2016; Tang and Liou 2010). The evolutionary fitness of dynamic capabilities with a time dimension offers a valuable view of sustained competitive advantages facing a turbulent environment (Laaksonen and Peltoniemi 2018; Zollo and Winter 2002). It is important for exporting firms pursuing long-term performance to understand the sustained strategy–sales relationships over time and the differences between the short- and long-term fit. Thus, we examine the lagged effect from past dynamic export pricing and past export sales.

Dynamic Export Pricing and Export Sales

Dynamic export pricing reflects firms' capabilities to adapt export pricing in real time (Levin et al. 2009). Traditionally, the pricing literature posits a static pricing regime wherein prices should not be changed dynamically (Cope 2007; Myers et al. 2002). An intrinsic property of static pricing regime is its lack of information (den Boer 2015). However, in the exporting context, enforcing static export prices (non-dynamic export pricing) leads firms to lose their strategic flexibility and can cause failure in foreign markets (Myers et al. 2002). Because exporting firms tend to have diminished control over foreign markets; non-dynamic export pricing prevents them from adapting their marketing competences to absorb external risks or taking advantage of market opportunities. Thus, there is a need to dynamically adjust export prices (up to a certain point), which helps to exploit firm internal competences and provides alternatives in generating superior export sales.

However, excessively increasing the degree of dynamic export pricing may damage export ventures' commitment and engender hazards in export sales (Liu and Zhang 2013). Customers tend to use their previously observed prices as a benchmark for the reference price, where large discrepancies between current prices and the reference price may delay or even cancel their purchases (Haws and Bearden 2006). Changes in export prices may necessitate foreign business customers to change their selling prices, as they may mark their own prices based on their purchasing prices. If foreign business customers have concerns/problems with changing their own prices, they may hesitate/postpone purchases from exporters with a high degree of pricing dynamism. In addition, implementing dynamic export pricing requires investment in relevant strategic resources (e.g., monitoring markets and tracking changes) (Cope 2007). Due to limited resources and operating budgets, exporting firms may find that ever-increasing efforts towards dynamic export pricing are costly, which in turn may result in loss of export sales (Cadogan et al. 2009).

Consequently, dynamic export pricing is considered as a "double-edged sword". On the one hand, under-dynamic export pricing reduces strategic flexibility. On the other hand, over-dynamic export pricing brings new hazards which may damage the market commitment (Liu and Zhang 2013). We suggest that, up to a certain level, export pricing dynamism initially leads to increased export sales. However, beyond this optimal point, excessively dynamic export pricing results in lower export sales, as such strategic dynamism may be considered "too much". There is a feasible turning point that represents the best dynamic export pricing effort and brings the maximum export sales. Accordingly, we propose a concave relationship between dynamic export pricing and export sales as stated below:

H1: There is an inverted U-curve relationship between the degree of dynamic export pricing and export sales.

Moderating Roles of Customer/Competitive Turbulence

The DC perspective posits that the deliberateness of the reconfiguration of resources and capabilities purposefully aligns with the environment (Chabowski and Mena 2017). Nevertheless, export markets' discontinuity and unpredictability create substantial managerial problems for export pricing efforts. We propose that customer and competitive turbulence can moderate the curvilinear relationship between dynamic export pricing and export sales in two distinct ways: it can (1) strengthen/weaken the shape of the curve, and (2) shift the turning point. These two types of moderating effects provide an in-depth view of the power of dynamic export pricing facing varying degrees of customer and competitive turbulence, which suggests the adaptation of strategic fit across export markets. Noticeably, such a fit between dynamic export pricing and turbulence is not a single score, but rather a set of correspondences between contingencies in a two-dimensional space, referred to as a fit line (Edwards 2002). The fit line is calculated as an optimization line after estimation, which connects all turning points of dynamic export pricing that generate the maximum export sales. As such, it suggests the customization of dynamic export pricing to fit individual foreign markets (Burkert et al. 2014). Export markets encourage export products with appropriate dynamic export pricing that fits with customer/competitive turbulence, and inhibit those that do not.

***Customer turbulence*.** Customer turbulence refers to the changes in customers' demands (Johnson et al. 2017). Under the condition of low customer turbulence, where the demand tends to be incremental and predictable, it is less pressing to adjust export pricing excessively and frequently (den Boer 2015). Past experience and tacit knowledge are helpful in predicting future customers' demands, thereby forecasting export sales. In this context, export managers are likely to commit to the *status quo* and keep export pricing dynamism at a relatively static

level (low dynamic export pricing) (Sousa et al. 2010). This is because low dynamic export pricing is easy to operate and saves the cost of adjusting (Gallego and Van Ryzin 1994). Moreover, in a relatively stable market, customers rely on rational expectations such that the observed price shapes their price expectation (Fornell et al. 1995). Rational expectations are consistent over time, where customers can easily recognize price changes (Fornell et al. 1995). In this context, extensively changing export prices would result in customers' forecasting errors, with customers tending to have stronger resistance to purchase. As such, in a market with low customer turbulence, over-dynamic export pricing provokes severe damage to export sales.

Conversely, under a high level of customer turbulence, customers are blurred and shifting. Firms face high flux in demand that is difficult to monitor and it is not possible to specify a priori for possible future customer demands (Eisenhardt and Martin 2000). In these markets, exporting firms cannot lock themselves into past strategic decisions, as past experience may become inappropriate in a particular situation. The DC perspective posits that, in high-velocity markets, dynamic capabilities should rely less on existing knowledge, but rapidly create new, situation-specific one instead (Eisenhardt and Martin 2000). Thus, facing high customer turbulence, flexibility becomes a more important requirement (Danneels and Sethi 2011). Exporting firms should proactively employ dynamic export pricing to align with external customer uncertainties. The best dynamic export pricing effort facing high customer turbulence tends to be higher than that facing low customer turbulence. Furthermore, high customer turbulence indicates that customers tend to have rapidly changing demands. They tend to be less sensitive to the changes in export prices, where over-dynamic export pricing leads to smaller damage to export sales. Thus, we propose that the inverted U-curve relationship between dynamic export pricing and export sales is moderated by customer turbulence, specifically:

H2(a): Customer turbulence flattens the inverted U-curve between dynamic export pricing and export sales, where under-dynamic export pricing performs better in an export market with low customer turbulence, and over-dynamic export pricing generally performs better in an export market with high customer turbulence. The best dynamic export pricing (turning point) increases with increasing customer turbulence.

Competitive turbulence. Competitive turbulence indicates the movements of competitors and changes in the heterogeneity and concentration of competitors (Danneels and Sethi 2011). Competitors' movements create pressure to justify the effect of an exporting firm's marketing strategies (Boso et al. 2013). If an exporting firm fails to effectively match its competitors' movements, it may lose its current markets and suffer from poor export sales. Regarding the moderating role of competitive turbulence, we consider that it has similar moderating effects, including both changes in the shape and shifts of the turning point. When competitive turbulence is low, export managers are capable of using their knowledge to predict their competitors' movements (Boso et al. 2013). In this context, referring to the DC perspective, small and deliberate adjustments in export pricing would provide a better fit with competitors' movements. Whereas, over-dynamic export pricing may ominously depress export sales and induce customers to purchase from competitors that are more stable and easier to predict.

In contrast, high competitive turbulence reflects the fact that competitors in foreign markets perform rapid movements and their strategic actions are difficult to predict (Schilke 2014). In such markets, the DC perspective considers that dynamic capabilities become increasingly important to enhance firm performance (Eisenhardt and Martin 2000). Exporting firms need to rapidly create competitor-specific knowledge that reconfigures their pricing strategies to coordinate the competitive turbulence. Hence, high dynamic export pricing provides a better

fit with high competitive turbulence. Moreover, foreign customers who are used to volatilities in supply become less sensitive to dynamic export pricing. Thus, the curvilinear relationship between dynamic export pricing and export sales is flattened under high competitive turbulence, where the negative slope of the curve is positively moderated by the increasing competitive turbulence, and vice versa. Thus, we consider that the inverted U- curve relationship between dynamic export pricing and export sales is also moderated by competitive turbulence, specifically:

H2(b): Competitive turbulence flattens the inverted U-curve between dynamic export pricing and export sales, where under-dynamic export pricing performs better in an export market with low competitive turbulence, and over-dynamic export pricing generally performs better in an export market with high competitive turbulence. The best dynamic export pricing (turning point) increases with increasing competitive turbulence.

Lagged Effects from Past Export Sales and Dynamic Export Pricing

Exporting firms' operations are not instantaneous activities, where past pricing strategies and sales outcome play non-negligible roles in shaping future export sales. The sustainability of competitive advantages is a long-term concern for firms (Wiggins and Ruefli 2002). In order to achieve a sustained competitive advantage, exporting firms need to take past information into consideration and understand the lagged influence from previously operated strategic decisions and the corresponding outcomes.

With respect to dynamic export pricing, past dynamic export pricing, referred to as the dynamic export pricing operated in the previous year, tends to have a carry-over influence on the following year's export sales. Both customers and competitors build up their expectations

of an export product through observing its history, and such perceptions shape their purchase intention and strategic reactions (Liu and Zhang 2013). This process takes time, which leads to lagged effects from past actions on later sales.

Regarding the lagged effect from export sales achieved in the previous year, referring to past export sales, Bernard and Jensen (2004) indicate that past success is the best indicator of the future. Past export sales could be used to calculate the posterior probability of a sustainable competitive advantage (Tang and Liou 2010). The DC perspective indicates the past success demonstrates a firm's superior capabilities in reconfiguring and redeploying its resources, thereby implying a higher probability of achieving superior performance at the subsequent stages (Chabowski and Mena 2017). Thus, we consider that past export sales are likely to have a positive effect on future export sales.

In addition, high sales tend to keep a firm in a misfit state (Donaldson 2001). Specifically, for an export product that has already achieved a fit in the export market, high sales are likely to cause it to expand by using slack resources to change its contingencies, e.g., exports to other foreign markets, so as to move into misfit. Then, the exporting firm will endeavor to shift the misfit into a new fit so as to maximize its export sales. The new fit with the feedback from the previously operated strategies and corresponding outcomes would become greater than the initial one. Thus, we consider that the lagged effect of past export pricing and export sales may positively shift the subsequent strategic fit, where the subsequent fitted strategies and outcomes become larger than the previous ones. Thus, both dynamic export pricing and corresponding export sales at fit points grow in the long run. Accordingly, we propose the following hypothesis regarding the lagged effect over time:

H3: Past dynamic export pricing and corresponding past export sales have positive effects on future export sales, thereby positively shifting the interactions between dynamic export pricing and customer/competitive turbulence.

DATA AND METHODOLOGY

Data

This study focuses on Chinese exporting firms. China has become the largest international trade country worldwide. Data were taken from three sources: the Chinese Industrial Enterprise Database (CIED), the Chinese Imports and Exports of Customhouse Database (CIECD), and the World Development Indicators (WDI) Database. The CIECD is a proprietary database authorized by the Chinese General Administration of Customs. It holds records of international transactions at Chinese customs from 2000 to 2009, and each record covers information including exporting firm name, product code, transaction quantity, transaction value, units, export country, and leaving port. The CIED covers Chinese enterprises' balance and accounting information (e.g., firm name, open year, firm size, total asset, ownership and industry) from 1999 to 2009. The WDI is compiled by the World Bank from officially recognized data resources, providing aggregated global economic development information, including exchange rate, market size, productivity, import value, and the Herfindahl-Hirschman (HHI) index.

The export data is available at a daily frequency, but we focused on the annual level. Transferring daily data into annual data is motivated by several considerations. First, daily data is likely to contain outliers and face interference from seasonality and lumpiness, which may generate misleading results (Manova and Zhang 2012). Annual data analysis can help us

to cast off these issues and focus on dynamic pricing strategy. Second, we explored the influence of the market development level on export sales. The market level factors are an annual index. If we had used daily data, the outcome would have contained statistical bias multiplied by the reduplicative number of observations without introducing sufficient new information (Manova and Zhang 2012). Hence, we aggregated the observations of the same product exported by the same exporting firm to the same export country. We summarized their export quantity and value within each year. As such, we obtained an annual-level export dataset containing the information of firm name, export country, year, annual export volume and annual export value. Then, the average unit price was calculated by dividing the annual-level export value by the export quantity.

In order to obtain the firm-year specific information, we merged the CIED databases with the aggregated annual product-level export dataset obtained above. Two datasets were matched by using the integrated information of firm name and year. We eliminated the redundant observations that were contained in the CIED but not in the annual-level export dataset, which were the observations from non-exporting Chinese firms. As a result, we obtained a merged dataset that contained the firm-specific and export-related information for individual products from each exporting firm to each foreign market each year.

In addition, in order to obtain the country-level information, the WDI database was merged with the integrated dataset by matching the information of country and year. The observations that were included in the WDI databased but not observed in the merged export dataset were omitted. Thus, the final dataset contained all export-related, firm-specific and export-country information for individual exporting products from Chinese exporting firms to foreign markets each year.

The export products had have missing information were omitted. In order to capture the long-term effects of export pricing strategy and explore the sustained competitive advantage, we selected the export products that had continuously exported to the same country throughout all ten years. Within each year, we were able to observe at least one record of the export transaction at the Chinese border. Finally, we obtained the final balanced panel dataset with 52,870 observations for analysis.

Measures

***Dynamic export pricing*.** As purchasing decisions are made discretely, we obtained a set of export prices for transactions within a year (Levin et al. 2009). The upward and downward trend movements of export prices throughout an operating year capture the dynamic export pricing (Tauchen et al. 1996). To identify the range of export pricing movements, we used the variance of percentage changes in export prices (Slade 1991). This measurement separates the random price movements and systematic trends, which shows the adjustments in price between two subsequent time points (Slade 1991). In order to allow the unit of dynamic export pricing to be consistent with the price level, we used the standard deviation instead of variance to measure dynamic export pricing. Full details are summarized in Appendix A.

Customer turbulence. Customer turbulence is defined as changes in demand (Johnson et al. 2017; Kok and Biemans 2009). Osadchiy et al. (2016) consider sales as a proxy for demand. In the exporting context, we used the total industry import value in the host market as a proxy for the demand in the foreign market for export products. Thus, we sought to capture customer turbulence by the coefficient of variance of the five-year change in the export markets' total import value.

Competitive turbulence. Competitive turbulence is considered as the changes in market competitiveness (Boso et al. 2013). We measured it using the coefficient of variance of the five-year change in the HHI index of the individual export markets (Feng et al. 2017).

***Export sales*.** We operationalized the annual export sales value of an export product in an export market to measure the export sales in this study (e.g., Bertrand 2011; Chen et al. 2019; Li et al. 2013). This scale provides objective sales-related and market-related measures of export sales performance (Sousa 2004; Sousa et al. 2014).

***Control variables*.** We included the export products' *prices in level* as one of the control variables. In addition, the literature suggests that some firm internal variables may affect export sales, including the firm size, firm ownership, firm experience, total asset and industry categories (Chen et al. 2016). We categorized *ownership* for Chinese firms into two types (i.e., fully state-owned enterprises and others) expressed by two dummy variables (He et al. 2013). We measured *firm size* by using the total number of employees (He et al. 2013). *Firm experience* is captured by using the age of a firm. *Total asset* is measured by the total amount of assets owned (in million RMB) by an exporting firm. *Industry* was measured by the first two digits of the four-digit industrial codes classified by the National Bureau of Statistics of China.

In terms of the external exogenous contextual variables, we controlled for the *exchange rate*, which was measured as the exchange rate between RMB and the currency of the export destination country. In addition, we controlled for *market size* (measured by the gross domestic product (GDP) of the foreign markets) and *productivity* (using the GDP per capita of foreign markets). Finally, by using the two-way fixed effect panel model, this study also controls for *year*-, *company*- and *export market*-level fixed effects.

Empirical Methodology

In order to test the hypotheses, we first used two-way fixed effect panel models to examine the interaction between dynamic export pricing and customer/competitive turbulence, and the corresponding effects on export sales from the longitudinal perspective. This is important as the time-specific and individual-specific fixed effects controlled for the heteroskedasticity and unobserved heterogeneity (Amiti and Khandelwal 2013; Feng et al. 2017). Regarding the moderation effect, we applied polynomial regression in order to assess the interaction between dynamic export pricing and environmental turbulence, which allowed us to extend the model in the spatial dimension and provide the fit lines (Edwards 2002). Thus, we assessed the conceptual framework by combing the two-way fixed effect panel model and polynomial regression as:

$$ES_{j\omega it} = \alpha_1 + \alpha_2 dpt_{j\omega it} + \alpha_3 dpt_{j\omega it}{}^2 + \alpha_4 M_{it} + \alpha_5 M_{it} dpt_{j\omega it} + \alpha_6 M_{it} dpt_{j\omega it}{}^2 + \eta_t C_t + \kappa_{ji} + \nu_t + \varepsilon_{j\omega it} \quad (1)$$

where j stands for exporting firm, ω for product, i for export country i, and t for time; $ES_{j\omega it}$ denotes product-level export sales; $dpt_{j\omega it}$ refers to the dynamic export pricing measured by standard deviation; M_{it} is the vector of environment conditions*;* C_t is the vector of control variables; κ_{ji} and ν_t are unknown firm specific and time specific effects respectively; and $\varepsilon_{j\omega it}$ is the residual term, which is assumed to be serially uncorrelated independent normal distributed with zero mean. As we focus on the customer and competitive turbulences, the environment conditions M_{it} is written as:

$$M_{it} = [cusT_{it}, comT_{it}] \quad (2)$$

where $cusT_{it}$ denotes the customer turbulence at time *t* in country *i*, and $comT_{it}$ denotes the competitive turbulence at time *t* in country *i*.

Then, in order to capture the feedback from the past dynamic export pricing and export sales at $(t-1)$, we introduce lagged variables as additional independent variables, formulated as:

$$ES_{j\omega it} = \gamma_1 + \beta ES_{j\omega i(t-1)} + \gamma_2 dpt_{j\omega it} + \gamma_3 dpt_{j\omega i(t-1)} + \gamma_4 M_{it} + \eta_t C_t + \kappa_{ji} + \varepsilon_{j\omega it} \quad (3)$$

where $(t-1)$ denotes the previous year.

Noticeably, the past dependent variable tends to correlate with current residuals that generate a serious concern for the endogeneity problem (Flannery and Hankins 2013). The traditional ordinary least-squared (OLS) estimation omits this endogeneity issue and leads to biased and inconsistent coefficient estimates (Arellano and Bond 1991). In order to control the endogeneity problem and provide unbiased estimations of lagged export sales, we employed a dynamic panel model with system GMM estimates and a robust covariance matrix (Flannery and Hankins 2013). The system GMM procedure combines both level and differenced functions as a system of equations that addresses the endogeneity concerns and generates consistent and efficient estimates (Garín-Munoz 2006). The first difference eliminates the time-invariant unobserved heterogeneity and removes the non-stationarity for the panel data, which thereby increases the confidence in the estimated coefficients and standard errors (Flannery and Hankins 2013). Thus, we sought to obtain the unbiased coefficient of lagged export sales using the system GMM dynamic panel model.

Results

Our final balanced panel dataset consisted of 5,287 export products exported to 92 countries each year. In total, we had 52,870 observations through ten years, and 47,583 for the lag-one-year panel. Table 2 presents the descriptive statistics and correlation metrics of the sample. A list of industry divisions, along with the number of firms, covered by the sample is provided in Appendix B.

Insert Table 2 about here

We made some necessary transformation to the data. First, we winsorized key variables by one percentile and took logarithmic transformation for continuous variables to reduce the influence of extreme observations and outliers. Second, we took the mean-centered value of all predictors before creating quadratic and interaction terms. This effort also facilitated the interpretation of the fit line (Edwards 2002). Table 3 summarizes the empirical results of customer turbulence and competitive turbulence.

Insert Table 3 about here

Specifically, Models 1–2 investigated the main effects and Models 3–6 explored the moderation effects. To better illustrate the two types of moderation effect on the curvilinear relationship, we examined the two moderators, customer turbulence (Models 3–4) and competitive turbulence (Models 5–6) separately. Finally, we added both moderators with four interaction terms in Model 7 to show the robustness of our results. All models were estimated by using the two-way fixed effect panel model which controlled for the specific individual and time effects. The results indicate that dynamic export pricing plays a non-negligible role in export sales.

In Model 2, we added the quadratic term of dynamic export pricing. The estimates for the first-order and second-order terms are 0.05 and -0.18 respectively, which generate the turning point value $\widehat{dpt_{J\omega lt}} = 0.14$, and this value falls into the mean-centered dynamic export pricing [-0.46, 2.72]. This result consistently holds in other models. Thus, the results indicate that there is an inverted U-curve between dynamic export pricing and export sales, thereby supporting H1. The turning point of this inverted U-curve suggests the best dynamic export pricing effort that brings the maximum export sales.

With respect to the moderation effects, the results suggest that both customer turbulence and competitive turbulence play key roles in altering the relationship between dynamic export pricing and export sales. Specifically, regarding customer turbulence, the results suggest that customer turbulence significantly moderates the quadratic relationship between dynamic export pricing and export sales, where the estimated coefficient of the linear interaction is significantly negative (-0.74) and of the quadratic interaction is significant positive (1.00). The nature of the interactions between dynamic export pricing and customer turbulence is shown in Figure 1.

Insert Figure 1 about here

As shown in Figure 1, in excess of the turning point, the descending slope between dynamic export pricing and export sales is slower under high customer turbulence than that under low customer turbulence. This shows that, when customer turbulence is high, Over-estimated dynamic export pricing has smaller negative effects on export sales, which, in turn, shows relatively higher export sales. In contrast, low export pricing dynamism appears to have stronger positive effects on export sales in markets with low customer turbulence. Thus, the results support part of H2(a) regarding changes of shape, which states that customer turbulence flattens the inverted U-curve between dynamic export pricing and export sales.

Regarding the moderating role of competitive turbulence, the results suggest that the estimated coefficients of both linear and quadratic interactions are significantly positive (1.49 and 1.25, respectively). The nature of the interactions between dynamic export pricing and competitive turbulence is shown in Figure 2.

Insert Figure 2 about here

Figure 2 shows that the shape of the inverted U-curve between dynamic export pricing and export sales is flattened by competitive turbulence. The results suggest that, in an export market with high competitive turbulence, the quadratic curve between dynamic export pricing and export sales tends to have slower ascending and descending slopes. In this context, beyond the turning point, a unit increase in dynamic export pricing tends to have smaller negative effects on export sales. Thus, the results support part of H2(b) regarding changes of shape.

Model 7 shows consistent results as reported above. We use the estimates from Model 7 and calculate the fit lines as:

$$\begin{cases} customer: \widehat{dpt} = (0.05 - 1.65 * cusT) \,/[2 * (0.20 - 0.96 * cusT)] \\ competitive: \widehat{dpt} = (0.05 + 1.03 * comT) \,/[2 * (0.20 - 0.94 * comT)] \end{cases} \quad (4)$$

These lines connect all turning points, which shows the fit between the strategic decision (dynamic export pricing) and the contextual variables (customer turbulence and competitive turbulence) in maximizing export sales. The calculation of the fit lines is provided in Appendix C. Figure 3 visualizes these two fit lines.

Insert Figure 3 about here

Unexpectedly, Figure 3(a) suggests that the best dynamic export pricing decreases along with increasing customer turbulence, which fails to support the hypothesised positive shift of turning point in H2(a). Combining with the results of flattening curve explained above, hypothesis H2(a) is partially supported. This trajectory shows that the fit between strategic dynamism and customer turbulence does not always hold in a positive way; high customer turbulence does not necessitate the need for high export pricing dynamism, and vice versa. In contrast, Figure 3(b) shows that there is a positive relationship between optimal dynamic export pricing and competitive turbulence, where the best dynamic export pricing practices increase along with the increasing competitive turbulence, which the hypothesised shift of turning point in H2(b). Combining with the results of flattening curve explained above, hypothesis H2(b) is supported.

Finally, in order to assess the lagged effect of dynamic export pricing and export sales over time, we add lagged export sales ($ES_{j\omega i(t-1)}$), lagged dynamic export pricing ($dpt_{j\omega i(t-1)}$) and lagged export price levels ($price_{j\omega i(t-1)}$) by one year. Due to the sales consistency, it is easy to suspect that the last-year export sales correlated with the current-year residual term $\varepsilon_{j\omega it}$ so that $ES_{j\omega i(t-1)}$ is considered as an endogenous variable. Facing the endogeneity concerns, the estimation results from the two-way fixed-effect panel model appear to be inconsistent and biased (Keele and Kelly 2006). To enhance the model, we applied dynamic panel model with a two-step system GMM estimation method that included both the level equation and the differenced equation. Following Blundell and Bond's (1998) method, both exogenous variables and the lagged differenced terms are used as the instruments of the endogenous variables. Table 4 summarizes the estimations from the system GMM dynamic panel model and the corresponding long-term coefficients.

Insert Table 4 about here

As Table 4 indicates, the p-value of Sargan test and the Hansen test were 0.40 and 0.26 respectively, both of which suggest valid and good-quality instruments that were not overidentified. In addition, the autocorrelation test results of AR(1) ($z = -4.44$, $p<0.001$) and AR(2) ($z = -0.67$, $p=0.50$) provide acceptance of underlying assumptions of significant first-order autocorrelation and non-significant second-order autocorrelation. Therefore, we conclude that the instruments employed in the models are valid, and the system GMM estimator is appropriate for our empirical work.

The results suggest that both previous year export sales and dynamic export pricing have significant positive effects on current year export sales. Based on the estimated coefficient of the lagged terms, $ES_{j\omega i(t-1)}$ and $dpt_{j\omega i(t-1)}$, we can calculate the long-term effects of dynamic export pricing on export sales. As shown in Table 4, past dynamic export pricing and export sales tends to positively affect the subsequent export sales (with estimates 0.24 and 0.64, respectively). The positive coefficient of past export sales leads to the accumulative effects past pricing strategies on subsequent export sales over time. In this case, such intertemporal effects positively shift the fit between dynamic export pricing and customer/competitive turbulence in the long run, thereby supporting H3.

In order to better demonstrate the differences between short-term and long-term relationships, we plotted the changes in the curve between dynamic export pricing and export sales, as shown in Figure 4. The dotted arrow in Figure 4 shows that long-term optimal dynamic export pricing is larger than short-term. Additionally, it suggests that a short-term fit does not necessarily lead to a long-term fit. Finding the trade-off between short-term fit and long-term sustainability is particularly important for export managers and researchers to consider.

Insert Figure 4 about here

Robustness Checks

To check the robustness of the results in this study, we carried out additional analyses. First, we checked our results using an alternative dependent variable. Export sales value is one indicator of export performance. It captures the objective value of export revenue. However, export sales cannot measure the magnitude of export activities in a firm's performance. A large firm can have greater objective export sales overall than small and medium-sized firms, but this does not necessarily indicate that this firm is a strong export performer. The multidimensional complexity of international performance (Katsikeas et al. 2006) and export performance (Katsikeas et al. 2000; Sousa 2004) has been acknowledged in the literature. Thus, we incorporated export intensity as an additional dependent variable, which is calculated as the proportion of export sales to firm overall sales, and re-ran our analysis. The results generated by the additional analysis were qualitatively similar to those reported above.

DISCUSSION

Although dynamic pricing has been widely studied, little is known about dynamic pricing in the exporting context. This study provides valuable insights into dynamic pricing efforts by empirically examining the power of dynamic pricing in an exporting context. The focus on dynamic export pricing augments traditional capacity-control revenue management by dynamically adjusting capacity allocations to different prices over time (Levin et al. 2009). Fast-moving customer preferences and intensive competition in the global market force exporting firms to be dynamic and flexible.

Noticeably, the strategic decision of dynamic export pricing is computationally intensive, as it is made at a highly disaggregated level regarding individual export products in individual export markets (Chen et al. 2017). By employing a large product-level transactional dataset, first, this study investigated an inverted U-curve relationship between dynamic export pricing and export sales. Second, this study further examined the moderating roles of customer and competitive turbulence in this inverted U-curve relationship from two mechanisms: changes of the curve and shifts of the turning point. Particularly, shifts of the turning point delineate the fit lines that pinpoint the best dynamic export pricing practice under different customer and competitive turbulences. Third, we examined the lagged influence from past export sales and dynamic export pricing on current export sales, which shed light on the '*sustainability'*. The findings show the evolutionary fitness of the dynamic strategy, which thereby provide a better understanding of how to achieve superior export sales in the long term.

Theoretical Implications

By investigating the quadratic relationship between dynamic export pricing and export sales, this study empirically shows that dynamic export pricing is not an arbitrary decision. The deliberation of dynamic export pricing is important for export sales, as dynamic export pricing can only improve export sales within a certain interval. The answer to the first research question is that only an intermediate level of export pricing dynamism can generate superior export sales. The results contribute to the theory by specifying the range of export pricing dynamism that ensures exporters' agility while enhancing export sales. Invariant export pricing leads to exporting firms losing their strategic flexibility and failing to compete in the fast-moving global market (Barreto 2010; Tang and Liou 2010). Dynamic capabilities are directed towards strategic changes in export pricing that enable exporting firms to obtain

greater sales. Nevertheless, ever-changing the export pricing strategy does not always provide benefits. Beyond a certain level, continuously increasing the emphasis on export price dynamics can be counterproductive to improving export sales (Liu and Zhang 2013).

In addition, dynamic capabilities are highly context specific (Schilke et al. 2018). Strategic changes need to align with the changing environment (Morgan et al. 2012). This study further investigates how customer/competitive turbulence moderates the curvilinear relationship between dynamic export pricing and export sales in two ways: (1) changes of the curve and (2) shifts of the turning point. This effort fills a gap in the literature with respect to the blurred moderation of U-curve highlighted by Haans et al., (2016), as a large proportion of studies do not consider these two distinct mechanisms of moderation on a curve. Moreover, the results facilitate the DC perspective by clarifying its boundary conditions, where the strategic changes need to fit individual markets. The strategic fit between dynamic export pricing and external turbulence suggests that the best dynamic export pricing effort is not isolated and unaltered, but varies across export markets with different customer and competitive turbulences.

By estimating the fit lines that connect all points of fit, we provide a policy of dynamic export pricing that empirically pinpoints the optimal dynamic export pricing in different export markets in order to achieve superior export sales. Regarding the second research question, our empirical results suggest that the best dynamic export pricing increases along with increasing competitive turbulence, but, surprisingly, decreases along with increasing customer turbulence. A possible reason for the negative relationship between the best dynamic export pricing and customer turbulence in export markets with high customer turbulence, is that constantly changing export pricing may be inappropriate. The DC perspective indicates that, faced with very high customer turbulence, the best approach is to stick to the fundamental

principle, as the processes exhibit little coherence (Eisenhardt and Martin 2000). Although exporting firms need to proactively employ dynamic export pricing when facing high customer turbulence, relatively low dynamic export pricing may be the best practice to enhance export sales.

These findings expand the scope of the DC perspective. Although Teece's (1997: 516) definition of dynamic capabilities depicts a "rapidly changing environment", it is important to note that the dynamic capabilities are not necessarily equivalent to a highly turbulent environment, whereas dynamic capabilities may still hold true in moderately dynamic or even stable markets (Eisenhardt and Martin 2000; Schilke 2014). The findings depict the applicable context of dynamic capabilities, where growing external turbulence is not always associated with increasing strategic changes.

Furthermore, previous strategic outcomes directed by dynamic capabilities continue to renewing a firm's resource repository, which creates superior sustained performance (Morgan et al. 2012). This study integrates time dimension and provides empirical evidence that past dynamic export pricing and past export sales tend to positively affect export sales in the future. This effort contributes to the empirical knowledge of the DC perspective by substantiating the effects and outcomes of dynamic capabilities over time. Audia et al. (2000) suggest that neglecting the significance of past sales may lead to overestimating the strategy–sales relationship. The results disclose the long-term evolution of the relationship between dynamic export pricing and export sales and provide an answer to the third research question. The results indicate that dynamic export pricing is not static over time, where the effect of dynamic export pricing on export sales differs between short- and long-term periods. In addition, the findings show that a temporal fit does not necessarily indicate a long-term fit,

where marginally over-estimated export pricing dynamism may potentially lead to a superior export sales in the long term.

Managerial Implications

This study offers useful practical implications for export managers. First, our study clearly demonstrates that dynamic export pricing is a helpful marketing instrument for businesses to practice in their export marketing to enhance their sales (Haws and Bearden 2006; Tan and Sousa 2011). Due to the limited control over foreign markets, managers of exporting firms need to employ dynamic export pricing to ensure their agility. However, managers should not assume they can ever increase the change rate of their export prices. What is more important for managers to understand is that the positive influence of dynamic export pricing on export sales varies when the extent of price change increases (or decreases), shaped as an inverted U. Dynamic export pricing improves export sales only up to a certain level; before this point, increasing export pricing dynamism raises export sales. Once the turning point has been passed, continuing to change export pricing widely becomes detrimental to sales as foreign buyers may postpone their buying or even turn to other sellers to avoid fast changing prices. Thus, it is important for export managers to understand this non-linear effect of dynamic export pricing on export sales and to examine the linkage within their company so that they can uncover the best level of dynamism for their prices to achieve superior sales in exporting.

Second, export managers are advised that the relationship between dynamic export pricing and export sales is subject to different influences of market situations: customer turbulence (i.e., changes of customers' demands) and competitive turbulence (i.e., changes of competitors' movements). When changes of customer demands are high and difficult to

predict, to achieve more export sales managers need to reduce the level of changes of their export prices (the dotted line in Figure 1). In contrast, if customer demands are less turbulent, then raising the degree of changes in prices helps to improve export sales up to an optimal point (the solid line in Figure 1). When the market is featured by a high rate of movements and differences in competitors, managers have more room to apply more dynamic pricing to match the export market for better export sales before reaching the turning point (the dotted line in Figure 2). In contrast, if the market is less turbulent, changing prices widely can hurt export sales quickly (the solid line in Figure 2).

Third, our results suggest that export managers need to continuously learn from their dynamic pricing practice and link it with the outcome of export sales. Specifically, our study indicates that past and current export sales and dynamic export pricing have positive effects on export sales in the future (Figure 4). Thus, dynamic export pricing can potentially provide a sustained competitive advantage if managers take care of their export pricing based on sales results and take into account the market conditions (customers and competitors). In particular, export managers should learn from their past pricing activities and export sales outcomes which are constantly under the influence of the turbulent international market environment and understand the pattern of the intertemporal changes to the strategic fits between them in order to make appropriate pricing decisions to enhance future export sales.

LIMITATIONS AND DIRECTIONS FOR FUTURE STUDIES

The implications drawn from this study may be tempered by several limitations. First, although very extensive, our sample is limited to manufacturing firms in one emerging country (China). Chinese firms are characterized by certain features (e.g., unique ownership,

unique affiliation with the government) that may limit the generalizability of our findings (Sousa and Tan 2015). Particularly, this may weaken the implications of the effect of country of origin. Future studies should, therefore, compare dynamic export pricing practices across different origin markets to offer further understanding of the influence of country of origin on dynamic export pricing efforts.

Second, although we have controlled for industry effects and largely analyzed from the B2B perspective given the nature and patterns of Chinese exporting practices, our dataset does not provide explicit information of the context: B2B or business-to-customer (B2C). The marketing contexts between B2B and B2C are different, and dynamic export pricing may vary (Zhang et al. 2014). In B2B situations, sellers can easily vary prices over time, while B2C retailers tend to be limited in their ability to change their prices for individual consumers (Zhang et al. 2014). Thus, future studies are suggested to empirically investigate different dynamic export pricing schemes in different marketing contexts.

Third, the current study examines dynamic pricing in an exporting context. Although exporting firms provide an excellent context in which to empirically investigate the efficiency of dynamic pricing underlying various market conditions, future studies are recommended to explore dynamic pricing efforts among other internationalization modes (e.g., joint venture, foreign direct investment). As a number of multinational firms tend to choose hybrid channels (He et al. 2013), it would be particularly worthwhile to examine dynamic pricing efforts across internationalization modes to further strengthen the understanding of dynamic pricing in international business.

Fourth, this study focuses on the dynamism of posted export prices. It is also worthwhile to consider that foreign customers may have different price sensitivities due to different levels of purchasing power. In this context, the price competitiveness can play an important role in

purchase decisions in some foreign markets. Further studies are encouraged to shed light on the competitive aspect in export pricing and investigate the dynamism of competitive pricing across different foreign markets.

Fifth, this study investigates the moderation of customer/competitive turbulence on the effects of dynamic export pricing, while another interesting angle would be to examine how past environment turbulence can influence next-stage export pricing. In other words, current dynamic pricing is set as a response to environmental changes that have occurred, where the effectiveness of such a response is further altered by changing environment. Hence, future studies are encouraged to expand the current conceptual framework and explore the lagged relationship between marketing strategies and changing environment.

Sixth, this study focuses on two dimensions of environmental turbulence (i.e., customer turbulence and competitive turbulence), both of which are highlighted by the DC perspective. Future studies are encouraged to consider other external environmental turbulences (e.g., government intervention, institutional dynamism). Regarding the external environment, psychic distance and cultural distance are two constructs that have also been found to play a major role in the firms' export operations (e.g., Sousa and Bradley 2006). However, little is known in the literature in terms of whether and how marketing capabilities overcome the challenges posed by psychic distance towards foreign markets (Dinner et al. 2018). This presents an opportunity for future researchers to investigate other environmental factors, which should further facilitate the DC perspective by refining its boundary conditions.

Seventh, the impact of managerial characteristics was not investigated in this study. However, it is generally accepted in the literature that managerial characteristics are critical in a firm's strategic decisions and outcomes. For instance, a number of studies have acknowledged that factors such as individual values (Sousa et al. 2010), aversion to risk (Giambona et al. 2017),

academic level (Ramón-Llorens et al. 2017), and international experience (Le and Kroll 2017) play a significant role in explaining firms' international operations. Thus, linking the ability to dynamically change export pricing strategies to the characteristics of the decision maker could provide a fruitful avenue for future research.

Finally, this study focuses on export sales. Although export sales is one of the most widely used measures to capture export performance (Chen et al. 2016; Katsikeas et al. 2000; Sousa 2004), it focuses on only one aspect of export performance that does not capture the whole domain of the construct. However, rather than considering this point as a limitation, we believe our decision to conceptualize our dependent variable as export sales should not be regarded as such. Currently, in the literature the most common approach is to refer in broad terms to export performance by selecting one or several variables to measure it with little or no conceptual justification. However, export performance is a complex and multidimensional construct in which trade-offs between different measures of export performance can be expected. While researchers often assume strong positive correlations between different variables used to measure export performance, a recent review found that this is not correct when measuring marketing performance (see Katsikeas et al. 2016). A similar argument could be made in the case of export performance. For instance, measures such as export market share and export profitability should not necessarily be expected to converge. Thus, future studies are encouraged to avoid conceptualizing and operationalizing export performance as a broad latent construct. Instead, focusing on different aspects of export performance (such as export sales in this study) and treating scale items separately is recommended for future studies in this area.

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APPENDICES

Appendix A: Measures of Dynamic Export Pricing

Specifically, the dynamic export pricing is estimated based on variance of percent changes in export prices (Slade 1991), define by

$$dp_{j\omega it} = var[\dot{p}_{j\omega iT}/p_{j\omega iT}]$$

where j stands for exporting firm, ω for product, i for export country, and T for time window; $p_{j\omega iT}$ represents a set of exporting prices of a product ω exported by firm j to the foreign country i in the time window T; $\dot{p}_{j\omega iT}$ denotes its time derivative. The variance is taken over all observed prices $p_{j\omega it^*}$ in the time window T, where t^* represents time points in corresponding to each observed prices in the T. In this study, we set $T = 2$ years, as some export products may only have one observation in an export country i within some certain years. The $\dot{p}_{jiT}/p_{jiT}$ is approximated by

$$\dot{p}_{j\omega it^*}/p_{j\omega it^*} = \ln(\dot{p}_{j\omega it^*}) - \ln(p_{j\omega i(t^*-1)}), \quad t^* \in T$$

The measurement is calculated by using a rolling window approach, which captures the changes of dynamic export pricing over time. Then, we use the standard deviate measure dynamic export pricing, written as:

$$dpt_{j\omega it} = st.dev[\dot{p}_{j\omega iT}/p_{j\omega iT}]$$

Appendix B: List of Industrial Demographics of Sample Firms

Industry	Number of firms	Percentage
Food products	1,650	3
Beverages	60	<1
Textiles	4,900	9
Wearing apparel	11,920	23
Leather and related products	4,190	8
Wood	190	<1
Paper and paper products	420	1
Printing and reproduction of recorded media	2,950	6
Manufacture of coke and refined petroleum products	1,810	3
Chemical products	80	<1
Pharmaceuticals, medicinal Chemical and botanical products	370	<1
Rubber and plastics products	4,150	8
Other non-metallic mineral products	2,090	4
Basic metals	250	<1
Fabricated metal products,	4,000	8
Computer, electronic and optical products	2,540	5
Electrical equipment	3,420	6
Machinery and equipment	4,200	8
Transport equipment	640	1
Furniture	190	<1
Other manufacturing	2,840	5
Electricity, gas, steam and air conditioning supply	10	<1
All firms	52,870	100

Appendix C: Calculation of Fit Lines

Fit line connects the turning point of the inverted quadratic curve across different conditions. In this study, the fit lines is calculated as the turning point of dynamic export pricing export across different customer turbulence and competitive turbulence. As our empirical results suggest the turning point exists throughout the feasible interval of customer/competitive turbulence, the fine line can be calculated by constraining the first derivative of the model equation (1) to equal zero (Haans et al. 2016). Thus, we obtain the line fit for dynamic export pricing in different export markets that brings the maximized export sales as:

$$\frac{\partial ES}{\partial dpt} = (\alpha_2 + \alpha_5 M_{it}) + 2 * (\alpha_3 + \alpha_6 M_{it}) dpt_{j\omega it} = 0$$

where the notations are consistent with equation (1).

TABLES

Table 1 Summary of the representative research on dynamic pricing

Study	Research design	Data	Context	Industry	Customer
Rajan et al. (1992)	Conceptual modelling with numerical example	Numerical values based on an interview with a local supermarket manager	Monopoly	Retailing supermarket	Deterministic demand
Gallego and Van Ryzin (1994)	Conceptual modelling with numerical example	Numerical simulations	Imperfect competition (analogous monopoly)	Service	Demand depends on prices
Kopalle et al. (1996)	Conceptual modelling with numerical example	Numerical simulations	Monopoly and duopoly	-	Homogeneous and heterogeneous demand
Zhao and Zheng (2000)	Conceptual modelling with numerical experiments	Numerical simulations	Does not consider competition	Perishable products	Nonhomogeneous demand
Aviv and Pazgal (2005)	Conceptual modelling with numerical experiments	Numerical simulations	Not specified	Fashion-like goods	Uncertain demand
Haws and Bearden (2006)	Empirical study	Experiments	Not specified	Manipulated on-line DVD players' retailer	-
Cope (2007)	Conceptual modelling with numerical experiments	Numerical simulations	One retailer with direct competition	E-commerce markets	Random demand

Popescu and Wu (2007)	Conceptual modelling with numerical examples	Numerical simulations	Monopoly	Consumer goods	Demand is a linear function of internal reference prices
Levin et al. (2009)	Conceptual modelling with numerical experiments	Numerical simulations	Oligopoly	Perishable products	Stochastically homogeneous segments
Transchel and Minner (2009)	Conceptual modelling with numerical examples	Numerical simulations	Monopoly	Retailer	Demand is a linear function of price
Yuan and Han (2011)	Conceptual modelling with experiments	Experiment	Two sellers (duopoly)	Not specified	Demand is influenced by price expectations
Liu and Zhang (2013)	Conceptual modelling with numerical experiments	Numerical simulations	Two sellers (duopoly)	Vertically differentiated products	Heterogeneous demand
Şen (2013)	Conceptual modelling with numerical experiments	Numerical simulations	Not specified	Not specified	Exponential and linear demand function
Zhang et al. (2014)	Empirical	Actual transactional data (2007-2008)	B2B context, but does not consider competition	An aluminium retailer that sells to industrial buyers	Cross-buyer heterogeneity
Chen et al. (2017)	Conceptual modelling with numerical experiments	Numerical simulations	Not specified, but the model is based on one firm	Not specified	Demand is a linear function of internal reference prices

Table 2 Descriptive statistics

	Variable	1	2	3	4	5	6	7	8	9	10	11
1	Logarithmic export sales ($ES_{j\omega it}$)	1.00										
2	Dynamic export pricing ($dpt_{j\omega it}$)	-.09*** (.00)	1.00									
3	Customer turbulence ($cusT_{it}$)	.04*** (.00)	.00 (.18)	1.00								
4	Competitive turbulence ($comT_{it}$)	-.01 (.23)	-.05*** (.00)	.21*** (.00)	1.00							
5	Logarithmic price level ($price_{j\omega it}$)	.04*** (.00)	.14*** (.00)	.04*** (.00)	.00 (.18)	1.00						
6	Logarithmic experience ($Experience_{jt}$)	.05*** (.00)	.04*** (.00)	.33*** (.00)	.22*** (.00)	.09*** (.00)	1.00					
7	Logarithmic total asset ($Total\_asset_{jt}$)	.15*** (.00)	.04*** (.00)	.17*** (.00)	.09*** (.00)	.08*** (.00)	.20*** (.00)	1.00				
8	Logarithmic firm size ($Firm\_size_{jt}$)	.11*** (.00)	-.01 (.31)	.09*** (.00)	.03*** (.00)	.07*** (.00)	.17*** (.00)	.67*** (.00)	1.00			
9	Logarithmic exchange rate ($exchange_{it}$)	.10*** (.00)	.03*** (.00)	.14*** (.00)	.17*** (.00)	.07*** (.00)	.02*** (.00)	-.07*** (.00)	-.11*** (.00)	1.00		
10	Logarithmic market size ($Market\ size_{it}$)	.21*** (.00)	.10*** (.00)	-.07*** (.00)	-.30*** (.00)	.14*** (.00)	-.06*** (.00)	-.20*** (.00)	-.12*** (.00)	.03*** (.00)	1.00	
11	Logarithmic productivity ($Productivity_{it}$)	.08*** (.00)	.03*** (.00)	.20*** (.00)	-.26*** (.00)	.09*** (.00)	-.02* (.04)	-.22*** (.00)	-.10*** (.00)	-.29*** (.00)	.57*** (.00)	1.00
	Mean	12.19	.41	.15	.07	1.55	2.35	11.21	6.19	.18	27.67	1.06
	Standard deviation	2.11	.46	.07	.04	1.63	.49	1.44	1.14	2.49	1.75	.94
	Minimum	0	0	.02	.00	-5.61	0	6.65	1.10	-5.66	2.13	5.10
	Maximum	20.32	3.18	.38	.20	13.29	4.45	17.08	9.69	8.21	3.32	11.48

† if p < .10, * p < .05, ** p < .01, *** p < .001. The numbers in parentheses are p-value.

Table 3
Moderating effects of (a) customer turbulence and (b) competitive turbulence on dynamic export pricing-export sales

Dependent: $ES_{j\omega it}$	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Independent							
$dpt_{j\omega it}$	-.12***	.05†	.05†	.05†	.05†	.05†	.05†
	(.02)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)
${dpt_{j\omega it}}^2$		-.18***	-.18***	-.19***	-.19***	-.19***	-.20***
		(.02)	(.02)	(.02)	(.02)	(.02)	(.02)
Moderators							
$cusT_{it}$	.07	.08	.06	-.14	.08	.08	-.13
	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)
$comT_{it}$	.36†	.35†	.31	.28	.39*	.15	.15
	(.18)	(.18)	(.18)	(.19)	(.19)	(.21)	(.21)
Interactions							
$cusT_{it} * dpt_{j\omega it}$			-.74***	-1.54***			-1.65***
			(.20)	(.30)			(.31)
$comT_{it} * dpt_{j\omega it}$					1.49***	.48	1.03†
					(.38)	(.55)	(.55)
$cusT_{it} * {dpt_{j\omega it}}^2$				1.00***			.96***
				(.28)			(.29)
$comT_{it} * {dpt_{j\omega it}}^2$						1.25*	.94†
						(.49)	(.50)
Controls							
$price_{j\omega it}$	.26***	.25***	.25***	.25***	.25***	.26***	.26***
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
$Experience_{jt}$	.02	.02	.01	.01	.01	.02	.01
	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)
$Total\_asset_{jt}$	.16***	.16***	.16***	.16***	.16***	.16***	.16***
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
$Firm\_size_{jt}$	.28***	.28***	.28***	.28***	.28***	.28***	.28***
	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)
$exchange_{it}$	.01	.01	.01	.01	.02	.01	.01
	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)
$Market\ size_{it}$	.95***	.96***	.94***	.90***	.96***	.96***	.90***
	(.17)	(.17)	(.17)	(.17)	(.17)	(.17)	(.17)
$Productivity_{it}$	-.44*	-.45*	-.44*	-.40*	-.46*	-.46**	-.42*
	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)
Ownership	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Export market	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Company	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	.11	.12	.12	.12	.12	.12	.12

† if p < .10, * p < .05, ** p < .01, *** p < .001
The numbers in parentheses are standard errors.

Table 4
System GMM model of dynamic export pricing on export sales and the long-run coefficients

Dependent: ES_{jit}	Coefficient	Std.Err.	Long-term coefficient	Std.Err.
$ES_{j\omega i(t-1)}$	.64***	.15		
$dpt_{j\omega it}$	-.30†	.18	-.82	.56
$dpt_{j\omega i(t-1)}$	.24†	.14	.65	.52
Moderators				
$cusT_{it}$	-34.75	22.34	-95.23	94.26
$comT_{it}$	3.83	7.67	10.49	20.46
Control variables				
$price_{j\omega it}$	.19	.23	.52	.70
$price_{j\omega i(t-1)}$	-.62***	.16	-1.7†	1.02
$Experience_{jt}$	7.70*	3.17	21.09	14.75
$Total\_asset_{jt}$	-1.28	1.15	-3.51	4.27
$Firm\_size_{jt}$	4.00	2.19	10.96	9.44
$exchange_{it}$	2.34	1.55	6.55	6.72
$Market\ size_{it}$	-.58	.82	-1.59	2.82
$Productivity_{it}$	2.93	.22	8.04	8.86
Ownership	Yes			
Year	Yes			
AR(1) test	z = -4.44 p-value < .00			
AR(2) test	z = -.67, p-value = .50			
Sargan test	$\chi^2(6)$ = 6.22, p-value =.40			
Hansen test	$\chi^2(6)$ = 7.69, p-value =.26			

† if p < .10,
* p < .05,
** p < .01,
*** p < .001.

FIGURES

Figure 1

Moderating effects of customer turbulence on inverted quadratic relationship between dynamic export pricing and export sales

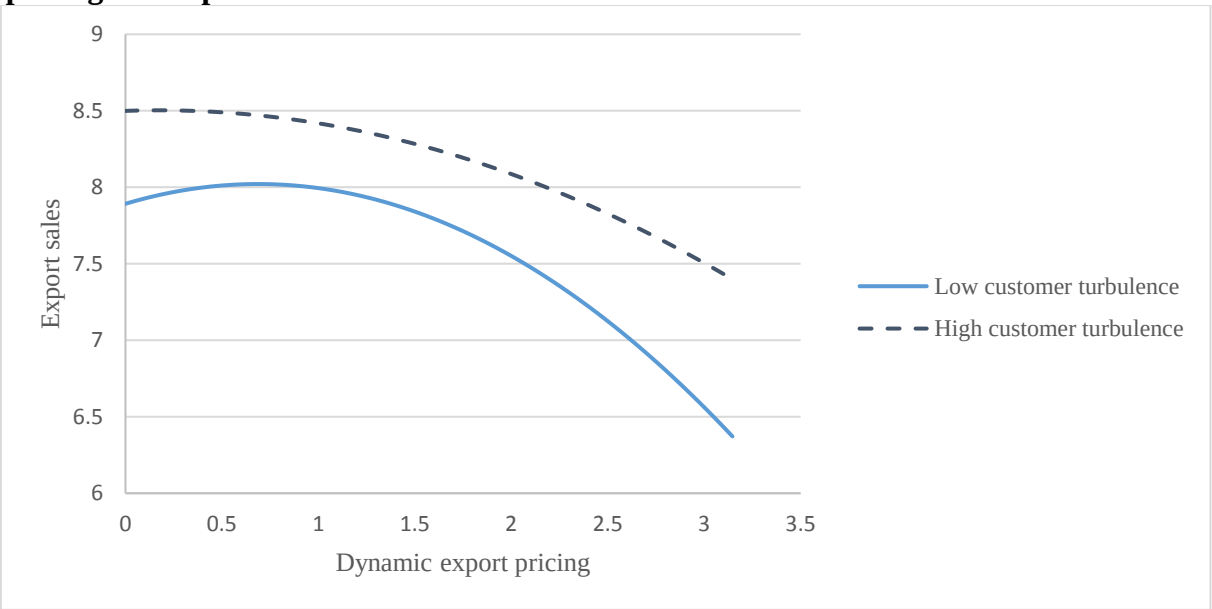


Figure 2

Moderating effects of competitive turbulence on inverted quadratic relationship between dynamic export pricing and export sales

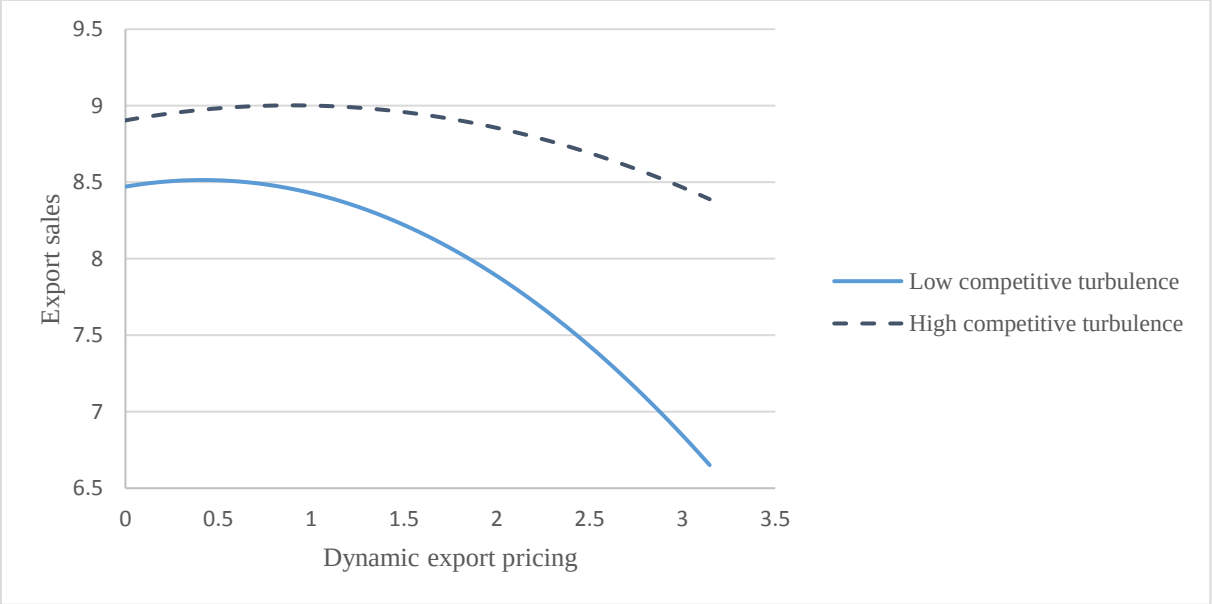
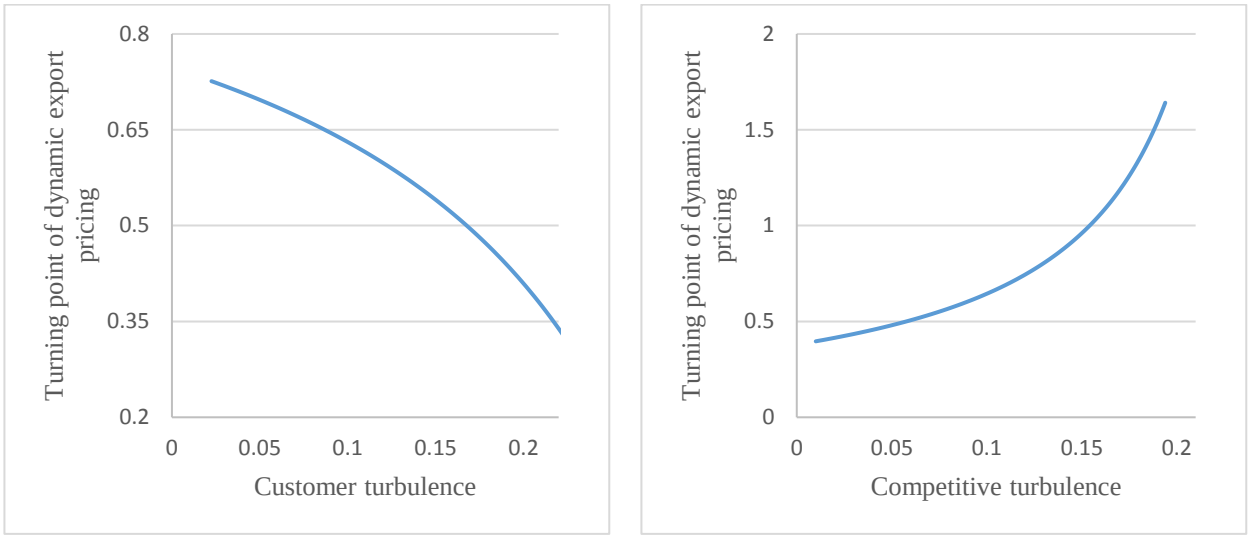


Figure 3

The fit lines between dynamic export pricing and (a) customer turbulence, (b) comeptitive turbulence in maximizing export sales



(a) (b)

Figure 4

Long-term and short-term relationships between dynamic export pricing and export sales